PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P 24532 PC	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. PCT/NO2004/000004	International filing date *(day/month/year)* 12-01-2004	Priority date *(day/month/year)*
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Maritime Communications Partner AS et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 15 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20-10-2005	06-03-2006
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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of: Cover sheet

International patent classification (IPC)
H04Q7/20(2006.01)
H04Q7/36(2006.01)
H04Q 7/38(2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO2004/000004

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages _____ as originally filed/furnished
pages* 1-9 received by this Authority on 20.10.2005
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 10 received by this Authority on 20.10.2005
pages* _____ received by this Authority on _____

☒ the drawings:

pages _____ as originally filed/furnished
pages* 1-5 received by this Authority on 20.10.2005
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO2004/000004

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1,2	YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims	1,2	NO
Industrial applicability (IA)	Claims	1-2	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to the problem of allowing a moving cellular radio network to operate in the vicinity of one or more other networks without interfering with transmissions associated with the other network/s.

Reference is made to the following documents:

D1: US 2002/0072328 A1
D2: US 2002/0082044 A1

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and discloses a method of managing a first mobile radio network, provided with a mobile infrastructure, located for example on a ship. The method initiates a procedure for determining and sharing frequencies wherein interference with a second fixed infrastructure mobile radio network which is using resources that are also being used on board the ship is avoided. Before calls are being set up with a wireless unit the transceiver of the first mobile network scans the various available frequencies in order to detect the presence of another radio network in the vicinity. Frequencies already in use by the other network are prohibited for the first network. A dialog with the purpose of agreeing on a frequency for setting up a connection between the two networks and for prohibiting the use of other frequencies is being executed, after which a connection is set up. (See [0032]; [0039]-[0045], claims 1-4).

D1 fails to suggest a frequency allocation procedure in which frequencies to be allowed or prohibited are retrieved from a storage. D1 also fails to suggest that stored frequencies are evaluated in dependence on the present location of the first mobile radio network (the ship).

The problem to be solved therefore is to derive an alternative

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V(I)

As for mobile radio networks in general, it is common practice to execute positioning of a mobile unit, for example with the help of GPS, to be used for various reasons. With this in mind also positioning of a mobile radio network located on a ship would be achieved by a person skilled in the art simply by utilisation of conventional technique and without the skilled person having to contribute with any inventive skill.

From D2 a system for communicating over a plurality of wireless networks is known. A reconfiguration procedure of a software defined radio is executed from a radio controller located on a remote mobile asset (12). The remote asset also comprise a first database (16), containing information about wireless networks (27), such as coverage area, service activation/authorization and valid licenses. From the stored information and positioning, a frequency/network which meet with certain requirements may be chosen. A frequency scanning device located on the remote asset is determining the presence or absence of pre-selected media broadcast frequencies, which are also being stored in a second database (18). The second database contains information related to license, frequency allocation and geographic location and is, together with the scanning information used as one possible option for location determination (See [0002];[0007]; [0013]-[0016]).

Consequently, a method for determining available frequencies by way of checking data in a database and by way of comparing the data to the present position of the remote asset is already known from D2. Since both documents refer to the same technical field and since no unexpected technical effect is achieved from this combination it is considered obvious to the person skilled in the art to combine these two documents and, thus, to come up with a solution which is equivalent to the one suggested in the amended claim 1. Therefore, this claim is novel and industrially applicable, but fails to involve an inventive step.

Claim 2 describes different rules for decisions to be made upon having evaluated frequencies stored in the database.

The system described in D2 also have the radio sensing equipment (radio scanning) which is necessary for detecting changes that has occurred in the radio environment. In addition, since the decisions which are proposed in claim 2 only results in prohibiting or allowing the use of certain frequencies under expected conditions it is considered obvious

.../...

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of: Box V(II)

that the method which is suggested in claim 2 also would be achievable by a person skilled in the art by way of combining D1 with D2, and by way of using common knowledge in this particular technical field. Therefore, also this claim is novel and industrially applicable, but fails to involve an inventive step.

MODE OF OPERATION OF A MOVING CELLULAR RADIO NETWORK

This invention concerns mode of operation of a moving cellular radio network. More particularly it includes mode of operation and design of a wireless radio network onboard a vessel. A radio network will serve a wireless handsets and cellular phones of passengers as well as of crew onboard the vessels. The mode of operation insures that, regardless of where the vessel sails, the onboard radio network will never interfere with other radio networks in the vessel's vicinity. Although a passenger ship is used as an example, the vessel can be any kind of vessel. The radio network can be of any type, including spread spectrum networks like Code-Division Multiple-Access (CDMA) or Wideband Code-Division Multiple-Access (WCDMA). However, the example describes a GSM (Global System for Mobile telecommunications) network with frequency adaptability. In spread spectrum systems the frequency adaptability will be replaced by a code- or other suitable adaptability.

Up to now it has not been possible to use mobile or cellular phones onboard ships moving beyond the service area boundaries of national land based radio networks. If currently available systems were to be installed on vessels without modification, these would infringe the frequencies assigned to the national Public Land Mobile networks (PLMNs.)

Systems for public land mobile networks have up to now been stationary. Each operator of such a radio network in a given geographical area, e.g. a country, is assigned certain frequencies different from the frequencies assigned to other op-

erators in the same area so as to avoid interference between these networks.

The installation of a public mobile network onboard a vessel presents an entirely new situation. The onboard radio network will move relative to other radio networks and can move into and out of areas where these other networks operate under licence from local authorities. The operator of an onboard radio network may not be assigned any frequencies from national or local authorities. There is a risk that such a radio network could use frequencies assigned to other networks unless it has the ability to conform to changing surroundings and local regulations. In the case where several vessels carry such a radio network we are faced with a scenario where several such networks move relative to each other. Consequently, in areas without specific regulations or licence agreements these networks are prone to using identical carrier frequencies.

US Patent Application 2002/0072328 describes a mobile infrastructure for wireless communications onboard ships. The mobile infrastructure scans the radio spectrum searching for control channels transmitted by base stations in fixed infrastructures. When a control channel (carrier) is detected, and the mobile infrastructure is within the service area of the fixed infrastructure, the mobile infrastructure will negotiate setting up a direct radio link to the fixed infrastructure. The available frequencies (carriers) will be shared between the two infrastructures, but controlled by the fixed infrastructure. The purpose of that invention is to avoid interfering with fixed infrastructures by avoiding using the same frequencies in both networks. Furthermore, it aims to reduce ship to shore communications costs by eliminating the use of a satellite link.

US Patent 5867785 describes a mobile infrastructure for wireless communications onboard trains. The mobile infrastructure includes a controller which scans the radio spectrum searching for control channels transmitted by base stations in fixed infrastructures. It then registers with the base sta-

tion controller in the fixed infrastructure through the base station with the best signal. The base stations in the mobile infrastructure are configured to use different frequencies than those used by the fixed infrastructure. The purpose of that invention is to reduce the amount of signalling during handover. This is achieved by handing over the entire mobile infrastructure rather than the individual cellular phone.

Both of those inventions contains methods for scanning and decoding the control channels transmitted by fixed infrastructures. In US Patent Application 2002/0072328 the decoded information is used to set up a direct connection to the fixed infrastructure on shore thereby avoiding the more costly satellite connection. In US Patent 5867785 the decoded information is used to log on to the base station controller in the fixed infrastructure. Both inventions depend on assigning and sharing the frequency resources controlled by the fixed infrastructure to avoid interference. Both inventions require that the fixed and the mobile infrastructures are parts of the same radio network or that there is a close cooperation between the fixed and mobile infrastructures. To achieve this, new functionality is required in both infrastructures.

US Patent Application 2002/0072328 does not describe how to adapt the mobile infrastructure when control channels from fixed infrastructures are detected. It merely states that detected frequencies shall not be used. Consequently, that solution is not ideal for a ship that repeatedly moves into and out of fixed radio network service areas. Similarly, to avoid interference, US Patent 5867785 takes advantage of the fact that trains move along predefined, known routes and not in a random fashion which ships are likely to do.

Both US Patent Application 2002/0072328 and US Patent 5867785 solve parts of the problem to be solved by this invention.

The purpose of this invention is to reduce one or more of the disadvantages or shortcomings of the known techniques.

This is achieved by using the methods and design as written in the following description and patent claims.

This invention is a method for adapting the radio network to its surrounding frequency environment and frequency regulations.

The invention enables moving wireless telephony infrastructures to dynamically adapt to the surrounding environment by avoiding frequencies occupied by other networks and frequencies for which there is no licence to use. The invention does not require cooperation between the moving radio network and other fixed or moving radio networks.

The method of listening to other infrastructures is a pure spectrum analysis of the relevant frequency bands without demodulating detected signals. In other words, the method employed generates a list of all used frequencies.

A control server controls the radio network by using information from a database about licences and agreements. Together with information from a positioning system, the frequencies that are allowed to be used in a certain area are identified. In addition, the list of used frequencies from the spectrum analysis is used to avoid any conflicts.

In the following an example of an preferred method is illustrated on the following drawings, where:

Fig. 1 shows a block diagram showing a radio network for mobile communication with corresponding facilities for use onboard vessels;

Fig. 2 shows a flow chart of the steps carried out by the control server;

Fig. 3 shows a flow cart related to the handling when new frequencies become available;

Fig. 4 shows a flow chart related to the handling of frequencies that becomes available; and

Fig. 5 shows a flow chart related to the handling of frequencies that must be discontinued.

Amended sheet

A GSM system is used as an example, but any radio network can be used.

The system includes the common resources 12 placed on shore (right hand side of figure 1), several remote units called Radio and Control systems 1 installed onboard vessels (left hand side of figure 1), and a satellite link 9, 10, and 11 which connects the remote units with the common resources and enables the establishment of communication links to/from public networks 13, public cellular networks 15, and other moving radio networks.

The satellite interface is capable of carrying multiple simultaneous traffic channels in addition to separate signalling channels. The system depicted in figure 1 is one of several possible configurations. Different distributions of equipment between the Radio and Control systems 1 and the common resources 12 are also possible.

The common resources in figure 1 include the central GSM (or alternative spread spectrum technology) functions Mobile Switching Centre (MSC), Visiting Location Register (VLR) and Home Location Register (HLR) 14.

The Radio and Control systems 1 on figure 1 include two parts. The first part is a radio network 2, which enables communication between cellular/mobile phones 16 on the vessel, and ship to shore communication to/from cellular/mobile phones or fixed network phones. The second part includes a control system 3, which controls and dynamically adapts the radio network 2 onboard to the surroundings.

The radio network 2 on the vessels includes base stations 5 handling the radio communication to and from the cellular/mobile phones 16 and a base station controller 4 that administers the base stations 5 and their frequency configuration.

The base station controller 4 on each vessel is connected to a common MSC, VLR, and HLR 14 via the satellite system 9, 10, and 11. Cellular/mobile phones 16 in the radio network 2 can

communicate with other public networks 13, public cellular/mobile networks 15, and other moving radio networks.

Calls between subscribers will be set up using the normal procedures for cellular networks, utilizing the satellite connection to the ship as a transmission path only.

The control system 3 includes a radio sensor 8, a positioning system 6 used to acquire the geographical position of the vessel, and a control server 7 running software to dynamically adapt the radio network 2 of the vessel. The radio sensor 8 could be a normal frequency scanner or spectrum analyzer which scans the frequency bands used for cellular/mobile communications. It is also possible to use the base station equipment 5 for this purpose. For spread spectrum technologies a similar scan and analysis of frequencies and codes must be carried out. The subsequent non-limiting description is based on using a spectrum analyzer.

The main objective of the control system 3 is to adapt the radio network 2 so that it at any given time avoids conflicts with other onboard or land based radio networks, and ensures that operation of the radio network 2 does not infringe the regulations concerning frequency usage of any geographical area the vessel moves into.

The control system uses several methods to adapt to its radio surroundings and the regulations that apply. The control system can reduce the transmitted power so that the signals do not propagate beyond the vessels boundaries, or shut down the radio transmission partly or totally. The control server can also change the use of base station carrier frequencies to use frequencies where the network is licensed to operate when applicable.

Availability of frequencies in regulated areas can be achieved by obtaining licence to use certain frequencies from the relevant national authorities or by signing agreements with local network operators that already have such licences.

The control system 3 achieves this by using a licence-database containing information about all given cellular ra-

dio frequency licences and regulations in the relevant area, their geographical boundaries and which of these frequencies are available for use by the operator of the radio network on the vessel. The position of the vessel is obtained from the positioning system 6. The position information is used together with the licence database in the control server 7 to decide what conditions are valid at any given time with respect to licences and commercial agreements. The control system also uses the information from the radio sensor 8 which continuously scans the relevant frequency bands in the vessel's vicinity. The information about available and occupied frequencies is used to adjust the use of frequencies in the radio network 2.

A non-limiting example of the control server's 7 use of and initial processing of data from the positioning system 6 is illustrated in the right half of the flow chart in fig. 2. At the start of this process, the control server 7 fetches new data from the positioning system 6 and checks whether the new data brings the vessel into a different licensing area. If the vessel moves into a new licensing area, the licence database is checked to see which frequencies are affected by the change. A change may lead to that a different set of frequencies becomes available for the radio network 2.

A non-limiting example of the control server's 7 use of and initial processing of data from the spectrum analyzer 8 is illustrated in the left half of the flow chart in fig. 2. At the start of this process, the control server 7 fetches information from the spectrum analyzer 8 and compares this information to the previous reading to decide whether there have been changes in the used frequencies in the relevant frequency band. The control system will discontinue the use of frequencies in its own radio network 2 if they are detected in the area. Similarly, the control system can make use of frequencies formerly detected as used by others, but have become available in the latest reading.

The flow chart in fig. 3 depicts a non-limiting example of how the control server 7 decides which actions to be taken in

the case when the conditions from fig. 2 change. The control system will, based on information from the positioning system 6 and the spectrum analyzer 8, decide which carrier frequencies to use and which not to use. This information is compared to the actual use of carrier frequencies in the radio network 2 and poses three possible scenarios:

Scenario 1: Carrier frequencies become fully or partly available to the radio network 2. Partly available means that the frequency can be used in the parts of the radio network 2 that do not cause signals to propagate outside the vessel.

Scenario 2: Carrier frequencies must be taken completely or partly out of service from the radio network 2. Partly out of service means that the frequency must be taken out of service from the parts of the radio network 2 that cause signals to propagate outside the vessel.

Scenario 3: Carrier frequencies are detected but are not in use by the radio network 2.

The handling when new carrier frequencies become available is depicted in the non-limiting example of the flowchart in fig. 4. The control server 7 decides whether it is necessary to use the available carrier frequency in those parts of the radio network 2 where it can be used. An automated frequency planning decides if it is possible to make use of the available frequency in the radio network 2 alongside the frequencies that are already used. If the control system decides to use the new frequency, the necessary reconfiguration of the base station controller 4 is initiated.

The handling of carrier frequencies which must be discontinued by the radio network 2 is depicted in the non-limiting example of the flow chart in fig. 5.

First the control system searches for a new frequency to replace the one to be discontinued. Information about available frequencies is stored in the control system and used with the automated frequency planning. Upon the decision to use a new carrier frequency, the control system will initiate the nec-

essary reconfiguration of the base stations 5 via the base station controller 4.

Patent claims

1. Method of operation of a control system (3) controlling a radio network for cellular/mobile communications (2) onboard a vessel enabling said vessel to move freely without interfering with other radio transmissions in the same area, characterised by that the control system uses data from a database containing information regarding frequency availability in regulated and unregulated areas, combined with data from a positioning system (6) in order to determine which radio frequencies are available to said radio network (2) at the vessel's current position, and where the control system (3) further uses information from a radio sensor (8), regarding the radio environment in order to determine whether frequencies listed as available in the database are unavailable due to other radio transmission in the area.

2. Method according to claim 1, characterised by that the control system (3) upon detection of a change in radio environment by the radio sensor (8), makes decisions regarding:

   - whether any frequency not in use by the radio network has become freely available;
   - whether any frequency not in use by the radio network has become available to the radio network for transmissions that does not propagate outside the vessel;
   - whether any frequency in use by the radio network has become unavailable to the radio network for transmissions that does propagate outside the vessel;
   - whether any frequency currently in use by the radio network has become totally unavailable to the radio network.

Amended sheet

PCT/NO2004/000004
20.10.2005

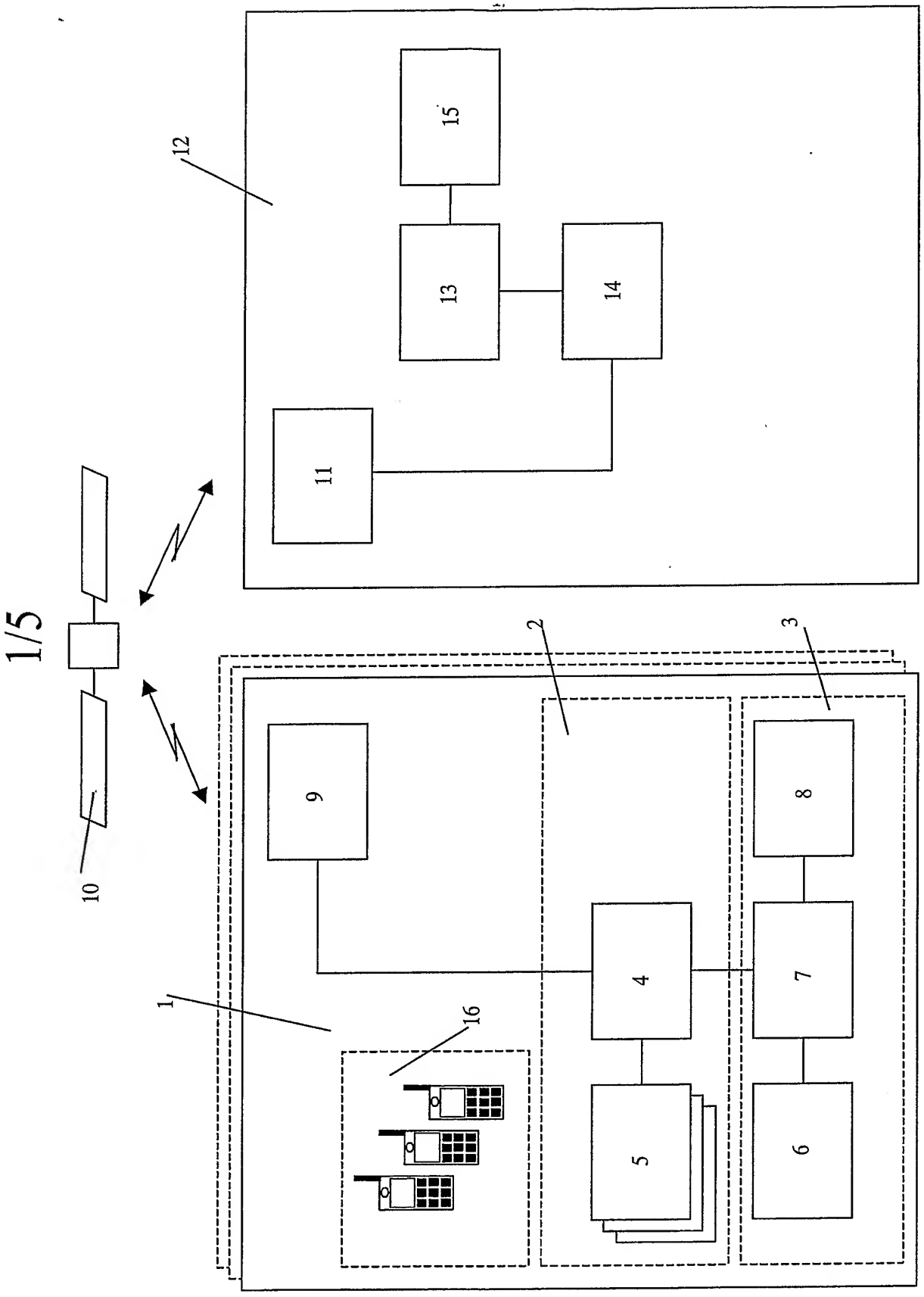

Fig. 1

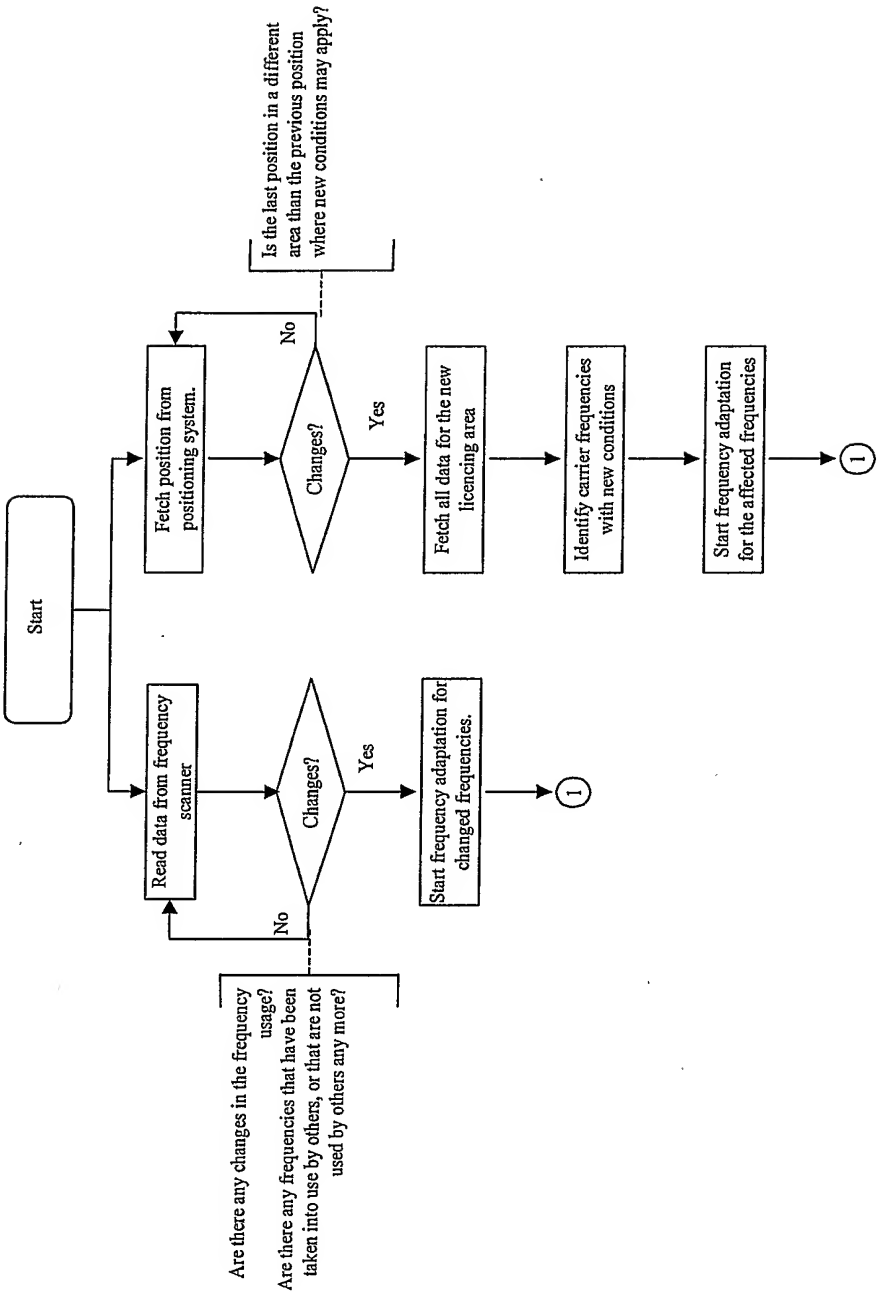
Start
Fetch position from positioning system.
Changes?
No
Yes
Is the last position in a different area than the previous position where new conditions may apply?
Fetch all data for the new licencing area
Identify carrier frequencies with new conditions
Start frequency adaptation for the affected frequencies
1
Read data from frequency scanner
Changes?
No
Yes
Are there any changes in the frequency usage?
Are there any frequencies that have been taken into use by others, or that are not used by others any more?
Start frequency adaptation for changed frequencies.
1

Fig. 2

2/5

3/5

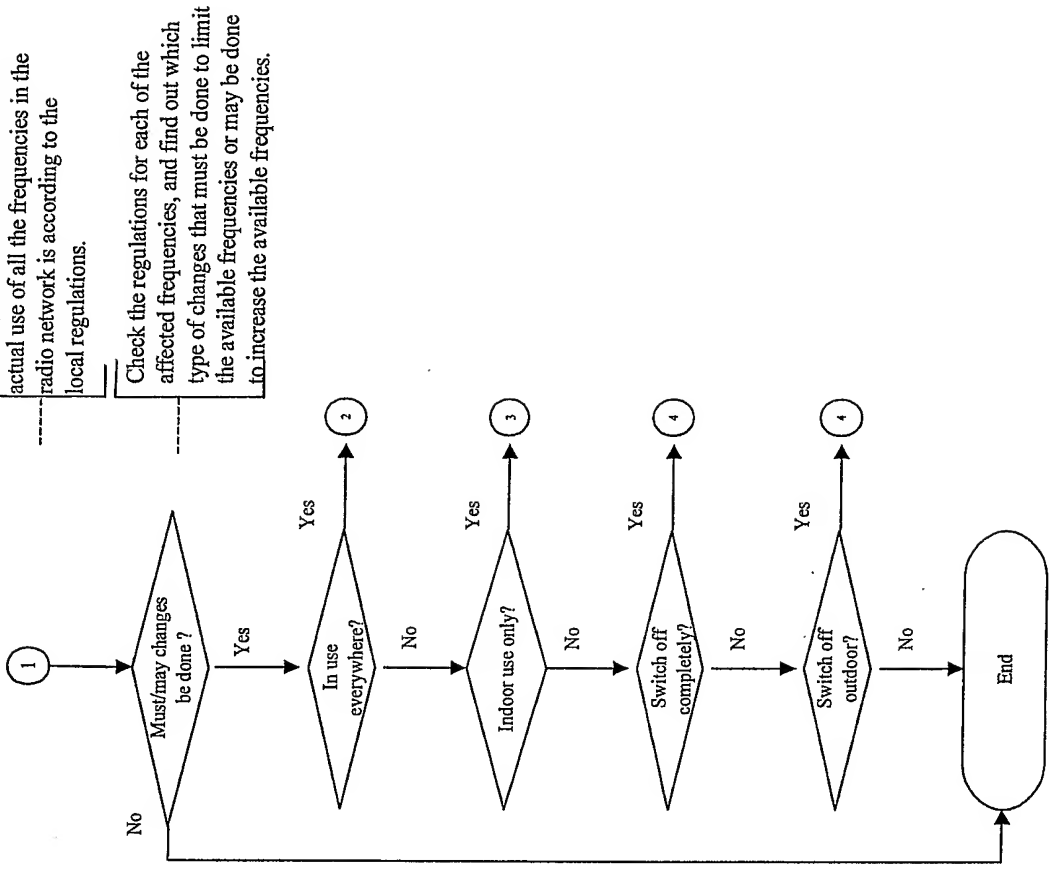
The purpose is to make sure that the actual use of all the frequencies in the radio network is according to the local regulations.
Check the regulations for each of the affected frequencies, and find out which type of changes that must be done to limit the available frequencies or may be done to increase the available frequencies.
1
Must/may changes be done ?
Yes
No
In use everywhere?
Yes
No
2
Indoor use only?
Yes
No
3
Switch off completely?
Yes
No
4
Switch off outdoor?
Yes
No
4
End

Fig. 3

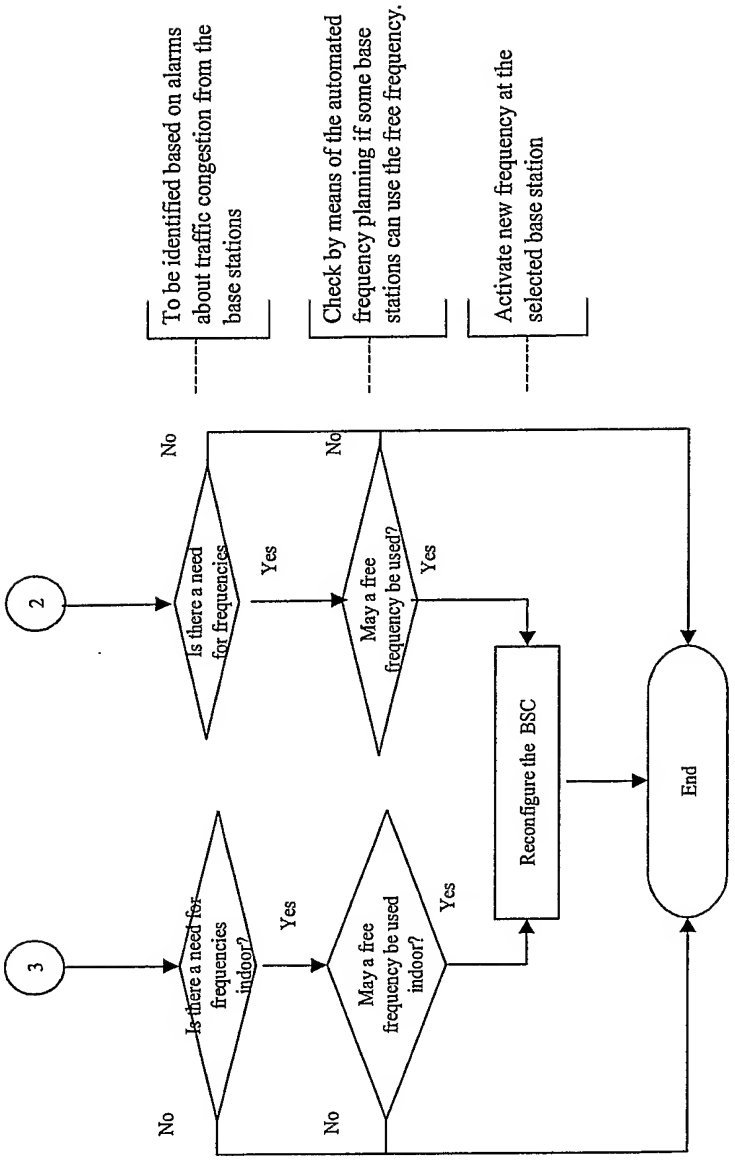
To be identified based on alarms about traffic congestion from the base stations
Check by means of the automated frequency planning if some base stations can use the free frequency.
Activate new frequency at the selected base station
2
3
Is there a need for frequencies
Yes
No
May a free frequency be used?
Yes
No
Is there a need for frequencies indoor?
Yes
No
May a free frequency be used indoor?
Yes
No
Reconfigure the BSC
End

Fig. 4

4/5

5/5

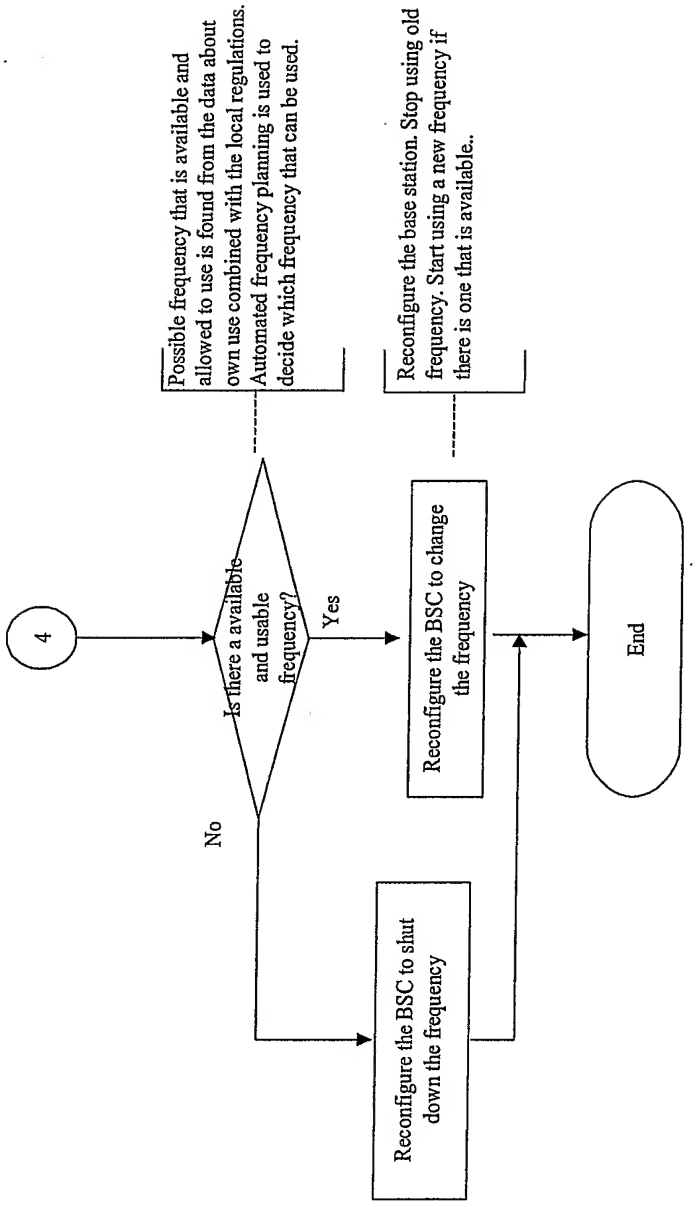
4
Is there a available and usable frequency?
Yes
No
Possible frequency that is available and allowed to use is found from the data about own use combined with the local regulations. Automated frequency planning is used to decide which frequency that can be used.
Reconfigure the base station. Stop using old frequency. Start using a new frequency if there is one that is available..
Reconfigure the BSC to change the frequency
Reconfigure the BSC to shut down the frequency
End

Fig. 5